24/10/2015

sheet (2) Fluid properties

Dimension: is used to describe the basic concept like: Mass, length, time and temperature.

unit: are the means of expressing the value of dimension numerically.

Length is dimension but centimeters and inches are both numerical units.

unit systems

SI النظام العالمي	EE	BG النظام الإنجليزي
international system.	English Engineering	British gravitational or English system.
m	Ft	Ft
kg	lb_m	slug
s	S	s
k	R	R

(b)

1 ft = 0.3048 m

1 in = 25.4 mm = 25.4×10^{-3} m

1 slug = 14.59 Kg

1 lbf = 4.448 N

1 slug = 32.174 lbm

1 gallon (UK) = 4.546 litre

1 gallon (US) = 3.785 litre

g = 9.81 m/s^2 = 32.174 ft/s^2

ρ_{H_2O} = 1000 Kg/m^3 = 1.94 $slug/ft^3$

1 hp = 735 watt

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sheet (2) No. (1) $\gamma = 96.5$ lb/ft^3

what (a) ρ (b) ν (c) S.G.

Solution

Notes

$\rho = \frac{m}{\forall}$ ← kg/m^3

$S.G = \frac{\rho}{\rho_{H_2O}}$ (liquid)

$S.G = \frac{\rho}{\rho_{air}}$ (Gases)

sp weight (γ) = $\rho g = \frac{W}{\forall}$ ($\rho g \forall$)

→ N/m^3

Solution

$\gamma = \rho . g$

$46.5 = \rho * 32.174$

$\rho = //$ slug/ft³

$v = \frac{1}{\rho} = \frac{1}{\ldots} = //$ ft³/slug

$S.G = \frac{\rho}{\rho_{H_2O}} = \frac{\ldots}{1.94}$

sheet (2) No. (2)

$m = 2$ slug ⟶ $g = 32.174$ ft/s²

$m = ??$ ⟶ $g = 30$ ft/s²

but (mass is constant.
but ($w = m * g$ ← متغيرة

sheet (2) No. (3)

weight = 100 lbf

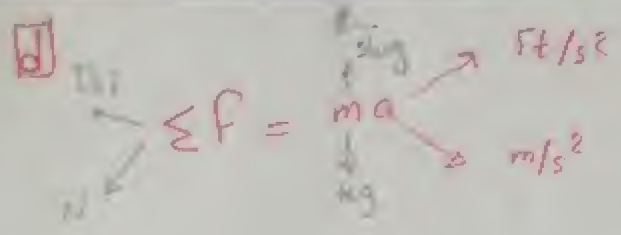
Determin (a) $w = ??$ N (b) $m = ??$ kg.
(c) $a = ??$ ft/s² $= ??$ m/s² at $\Sigma F = 50$ lbf

Solution

$w = 100 * 4.448 = 444.8$ N

$m = \frac{444.8}{5.81} = 44.48$ kg

9



$\Sigma F = 50\ lbf = 44.48\ kg \cdot a$

14.59

$a = \_\_\_\_\ Ft/s^2$

$50 - 4.448 = 44.48 \cdot a$

$a = \_\_\_\_\ m/s^2$

	MLT	FLT
mass	M	$FL^{-1}T^2$
length	L	L
time	T	T
force	MLT^{-2}	F
velocity	LT^{-1}	LT^{-1}
pressure	$ML^{-1}T^{-2}$	FL^{-2}
work	ML^2T^{-2}	$F*L$

No. (14)

Data	MLT	FLT
(a) Force × Volume	$MLT^{-2} \cdot L^3 = ML^4T^{-2}$	$F \cdot L^3 = FL^3$
(b) Pressure × Mass / Area	$\frac{ML^{-1}T^{-2} \cdot M}{L^2} = M^2L^{-3}T^{-2}$	$\frac{FL^{-2} \cdot FL^2T^2}{L^2} = F^2L^{-2}T^2$
(c) Moment / velocity	$\frac{ML^2T^{-2}}{LT^{-1}} = ML^1T^{-1}$	$\frac{FL}{LT^{-1}} = FT$
(d) Volume × Mass / velocity	$\frac{L^3 \cdot M}{LT^{-1}} = ML^2T$	$\frac{L^3 \cdot FL^{-1}T^2}{LT^{-1}} = FL^2T^3$

No. (7) → SI

(a) 4.81 slug = $4.81 * 14.59 = 70.17$ kg

(b) 3.02 lb = $3.02 * 4.448 = 13.432$ N

(c) 73.1 ft/s^2 = $73.1 * 0.3048 = 21.93$ m/s^2

(d) 0.0234 $\frac{lb.s}{ft^2}$ = $\frac{0.0234 * 4.448}{(0.304)^2} = 1.156$ $\frac{N.s}{m^2}$

(e) 10.2 in/min = $\frac{10.2 * 254 * 10^{-3}}{60} = 4.318 * 10^{-3}$ m/s

(f) 79.1 hp = $79.1 * 735 = 58138.5$ W

(g) 15 gallon (us) = $15 * 3.785 = 56.775$ litre

F

1 m = 3.28 ft 1 kg = 0.058 slug

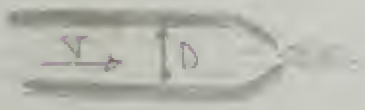
1 N = 0.224 lbf

(a) acceleration m/s^2 = 3.28 Ft/s^2

(b) Density kg/m^3 = $\frac{1 * 0.058}{(3.28)^3}$ = ∴ $\frac{slug}{Ft^3}$

No. 5

$h = (0.04 \text{ to } 0.09) * \left(\frac{D}{d}\right)^4 * \frac{V^2}{2g}$



h: energy loss per unit weight

$\left(R.H.S = (0.04 \text{ to } 0.09)\left(\frac{L}{L}\right)^4\left(\frac{L^2T^{-2}}{2LT^{-2}}\right) = L \right)$

L.H.S = $\frac{\text{Force} * \text{length}}{\text{weight}} = L$

∴ L.H.S = R.H.S = L ※